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REVIEW OF SECTORAL CLUSTERS, FIRST PHASE: TOXIC CHEMICALS AND HAZARDOUS WASTES

Radioactive wastes

Report of the Secretary-General

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INTRODUCTION

1. The Economic and Social Council, in its decision 1993/314 of 29 July 1993, approved the provisional agenda for the second session of the Commission on Sustainable Development. Item 6 (b) of the agenda provided for a review of sectoral clusters, first phase: toxic chemicals and hazardous wastes (including radioactive wastes).

2. As set forth in the report of the Commission on Sustainable Development on its first session, 1/ the Secretary-General was requested to prepare analytical reports for future sessions of the Commission. It was stated that thematic reports (such as the present one, corresponding to the Agenda 21 2/ sectoral clusters to be included on the agendas of forthcoming sessions of the Commission, should include, information, inter alia, on the main activities that countries were undertaking or planning. 3/ In order to give the United Nations Secretariat sufficient time for the analysis of information received, the Commission encouraged Governments to submit their information not less than six months prior to the Commission's sessions. 4/ Unfortunately, the Secretariat had received only a few national reports at the time of the preparation of this report. The coverage is therefore far from complete.

I. GENERAL OVERVIEW

3. The past four decades have witnessed sharp accumulations of radioactive wastes generated from nuclear weapons programmes, electric power generation and nuclear applications in medicine, and the production of radioisotopes. Radioactive wastes have radiologic and safety risks, which vary considerably according to whether the wastes are low-, intermediate- or high-level and whether they are short- or long-lived. It is estimated that about 200,000 cubic meters of low- and intermediate-level wastes and 10,000 cubic metres of high-level wastes are generated annually (1991) from the nuclear power fuel cycle. Estimates of radioactive wastes (high-level) from nuclear weapons programmes are not readily available, although their magnitude is bound to be high. The high-level waste, whose composition is about 99 per cent radionuclides, represents the largest radiologic risk. It presents the biggest management problems with regard to safe, permanent disposal, given that most have long half-lives (millions of years). In this respect, it has been reported that since the Second World War, the United States of America, the former Union of Soviet Socialist Republics, China, the United Kingdom of Great Britain and Northern Ireland and France have together produced a large number of nuclear warheads. Disarmament agreements among the nuclear powers call for a reduction and dismantling of nuclear warheads with costs estimated at $1 billion per year for the United States alone. What will ultimately happen to the fissile materials once warheads are removed remains unclear. Neither the United States nor the Russian Federation has available currently facilities either to store plutonium permanently or to dispose of it in a way that does not pose dangers to future generations. 5/

4. The generation of radioactive wastes from electric power stations is likely to increase. In addition, more countries will be involved (see table). That many of the countries with nuclear powerplants do not have the capacity to reprocess spent nuclear fuel thus necessitates transportation to processing facilities in other countries with consequent safety implications and potential unauthorized diversion.

5. The disposal of high-level waste presents major problems, and although many studies have been done, the achievement of a permanent safe disposal site has remained an elusive goal. Where such sites have been identified, there are still nagging questions as to whether they are adequate to deal with the sheer mass of the waste. At present, radioactive wastes from nuclear powerplants are stored on site but some storage facilities at these sites are reaching full capacity, thus necessitating storage elsewhere or the shut-down of the plants. 6/ The original intention was that at-reactor-storage would be temporary until permanent facilities could be established. However, in the United States for example, the proposed permanent facilities at Yucca Mountain may not be ready for at least 10-20 years. Similarly, it is reported that early in the next century the storage capacity of Argentina's three nuclear powerplants will reach its limit, and the country will have to decide on where to place the radioactive waste. 7/ France, which depends more than any other country on nuclear energy, also faces serious radioactivity disposal problems and has had to relaunch long-stalled attempts to find a deep storage site for waste from its 57 reactors. 8/ Challenges also abound with regard to the sites for low-level wastes. There are simply not that many sites available. To this must be added the problem of local resistance to the location of sites. The costs for the disposal of medium-level waste have been rising steadily over the years, and estimates of future costs vary widely.

6. Decommissioning nuclear powerplants also constitutes a major headache. Estimates of decommissioning costs are high and steadily rising - of the order of billions of dollars per plant. For example, the projected costs of decommissioning the United Kingdom's Magnox reactors are reported to have increased from 2.5 billion pounds in 1988 to 4.8 billion pounds a year later. 9/ The structures and associated wastes will be unsafe for millions of years. Future generations will have to live with future nuclear structures or waste disposal sites left by current and immediate past generations or undertake the final stage of decommissioning, clean-up of sites and disposal of wastes. 10/ According to some experts, decommissioning of nuclear powerplants may be accelerated for a variety of technical and economic reasons as well as because of difficulties in the disposal of radioactive wastes. It has been reported that in the United States nuclear facilities were licensed by the Nuclear Regulatory Commission (NRC) to operate for a supposed 40-year life cycle but the 15 plants closed so far were open for an average of only 12.7 years. 11/

7. The problems associated with radioactive waste management and disposal are complex and multifaceted, touching on scientific, technical, geologic, economic, social, health, environmental, political and intergenerational factors. Developing countries are constrained by lack of funds, weak institutions and infrastructures, and dearth of trained and skilled scientific and technical manpower. They will require assistance from the international community in addressing these problems.

Status of nuclear power around the world

	In operation		Under construction	
	Number of units	Total net megawatts (MW)	Number of units	Total net megawatts (MW)
Argentina	2	935	1	692
Belgium	7	5 484		
Brazil	1	626	1	1 245
Bulgaria	6	3 538		
Canada	21	14 874	1	881
China	1	288	2	1 812
Cuba			2	816
Czech Republic	4	1 632	2	1 784
Finland	4	2 310		
France	56	57 688	5	7 125
Germany	21	22 559		
Hungary	4	1 729		
India	9	1 593	5	1 010
Iran (Islamic Republic of)			2	2 392
Japan	44	34 238	9	8 129
Kazakhstan	1	135		
Lithuania	2	2 760	1	1 380
Mexico	1	654	1	654
Netherlands	2	504		
Pakistan	1	125		
Republic of Korea	9	7 220	3	2 550

	In operation		Under construction	
	Number of units	Total net megawatts (MW)	Number of units	Total net megawatts (MW)
Romania			5	3 155
Russian Federation	28	18 893	18	14 175
Slovakia	4	1 632	4	1 552
Slovenia	1	632		
South Africa	2	1 842		
Spain	9	7 101		
Sweden	12	10 002		
Switzerland	5	2 952		
United Kingdom of Great Britain and Northern Ireland	37	12 066	1	1 188
Ukraine	15	13 020	6	5 700
United States of America	109	98 729	3	3 480
Total a/	424	330 651	72	59 720

Source: International Atomic Energy Agency (IAEA) Bulletin, vol. 35, No. 3 (1993).

Note: The data reflect status at the end of 1992 as reported to IAEA. For the United States the table does not reflect the reported shut-down of one plant in February 1993.

a/ Including Taiwan Province of China, where six reactors totalling 4,890 MW are in operation. In 1992 they accounted for 35.4 per cent of the total electricity generated there.

II. REVIEW OF PROGRESS ACHIEVED IN THE PROGRAMME AREA OF CHAPTER 22 OF AGENDA 21

Promoting the safe and environmentally sound management of radioactive wastes

8. The objective of the programme area of chapter 22 of Agenda 21 is to ensure that radioactive wastes are safely managed, transported, stored and disposed of, with a view to protecting human health and the environment, within a wider framework of an interactive and integrated approach to radioactive waste management and safety.

1. International cooperation

9. The International Atomic Energy Agency (IAEA) is the main operator in this field. 12/ It has restructured its radioactive waste management programme which now emphasizes the improvement of awareness of member States regarding the need to link closely the use of nuclear material with the requirements of a national waste management system. IAEA has initiated a special project, linked with the Waste Management Advisory Programme (WAMAP), which has provided advice on locating missing radioactive substances, on developing a standardized design for conditioning an interim storage facility for steamed fuel and on operating a database registry to track such sources. Several missions have been undertaken to assist developing countries in establishing and improving national radioactive waste management programmes.

10. IAEA has also provided guidance on minimization of radioactive waste from the nuclear fuel cycle, on advanced technologies for processing radioactive wastes and on policy regulation and planning for the decommissioning of nuclear facilities. The organization's Radioactive Waste Safety Standards (RADWASS) programme has given priority to the review for publication of waste management safety fundamentals and safety standards. Many documents have been and will be published in the following areas: planning, predisposal, near-surface disposal, geologic disposal, uranium/thorium mining and milling wastes, and decommissioning. The target is to publish about 10 high-priority RADWASS publications, depending on budget availability of resources.

11. IAEA is cooperating with Norway and the Russian Federation to investigate and assess radiologic impacts of the dumping of high-level radioactive wastes in the shallow waters of the Kara and Barents seas; such investigation will include the feasibility of remedial actions. The organization is also exploring ways and means of assisting countries in the northwest Pacific, in particular the Sea of Japan to address the issue of the reported dumping of radioactive wastes in that area.

12. IAEA General Conference, at its thirty-seventh session, held in October 1993, requested the Director-General to initiate preparations for a convention on the safety of waste management as soon as the ongoing process of developing waste management safety fundamentals has resulted in a broad international agreement. The General Conference also invited the agency's Board

of Governors and the Director-General to maintain the emphasis given to radioactive waste management, especially RADWASS, and to consider further means to enhance international cooperation in the field, including the assessment and the impact of land and sea disposal of waste.

13. The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) was amended in November 1993 in order to convert the voluntary moratorium on ocean dumping of all radioactive waste into a binding prohibition. The amendments entered into force in February 1994 and IAEA has been requested by the contracting parties to the Convention to develop quantitative limits for the exempt levels of radioactivity.

14. Meanwhile, the International Maritime Organization's (IMO) 18th Assembly (November 1993) adopted the Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-level Radioactive Waste in Flasks on Board Ships (the Irradiated Nuclear Fuel (INF) Code). The Code had been finalized by a joint IAEA/IMO/United Nations Environment Programme (UNEP) Working Group as called for in Agenda 21's Chapter 17 concerning, inter alia, protection of the oceans. The IMO Assembly, in a resolution adopting the Code, requested IMO in consultations with IAEA to consider, as a matter of high priority, relevant aspects of the transport of INF and other nuclear materials that are complementary to those covered in the INF Code, all these aspects taking into account the recommendations of the above-mentioned Working Group and the objectives of chapters 17 and 22 of Agenda 21.

15. A number of countries have reported on their ongoing or planned activities. Canada actively participates in international bodies such as IAEA, the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD), the International Commission on Radiological Protection, and the International Maritime Organization (through the London Convention).

16. The United States participates in radioactive waste management at the international level through information exchange and cooperative activities. It is a member of IAEA and participates in a number of the latter's activities, including RADWASS, the International Radioactive Waste Management Advisory Committee (INWAC), the Packaging and Transportation of Radioactive Materials (PATRAM), symposium, and the coordinated research programme in the behaviour of spent fuel and storage facility components during long-term storage (BEFAST). The United States, through the Department of Energy, also supports the activities of the Waste Management Advisory Programmes (WAMAP) which provides technical assistance to developing countries. As an active participant in IAEA activities, the United States supports efforts to develop safety standards, guidelines and codes of practices.

17. The United States is participating in the discussion on the possible changes to the London Convention dealing with ocean dumping of radioactive wastes. It is also engaged in a cooperative project with IAEA on radon exposure assessment, expected to be completed in 1994. A number of projects have been proposed for future joint Environmental Protection Agency (EPA)/Department of Energy cooperation. These include environmental remediation and risk management assistance to countries in economic transition and successor States of the

former Soviet Union. A second proposal for joint cooperation between the same agencies involves assessing the risks posed by radioactive waste packages and decommissioned nuclear reactors dumped in the Kara and Barents seas.

18. The Department of Energy also routinely exchanges information with other countries on radioactive waste management activities and promotes international understanding and consensus on radioactivity issues. To this end, it has entered into numerous agreements with countries, including Sweden (to conduct experimental and analytical work at the Hard Rock Laboratory); Spain (to exchange information on geologic site characterization, repository design and radioactive storage); Japan (in the areas of cooperative research on radionuclide transport; robotics, separation, site characterization etc.); Canada (in the areas of site characterization, laboratory testing, performance assessment); and Switzerland (in the area of site characterization). It is currently funding an exchange programme under a memorandum of cooperation with the Russian Federation in several areas including vitrification, containment transport modelling, separation technologies and academic programmes. EPA is actively involved and participates in international policy activities concerned with radiation protection and waste management issues.

19. The United States also participates in the activities of the Nuclear Energy Agency and has been active in the International Radioactive Waste Management Committee which reviews and gives directions to NEA project activity. The United States is a charter member of the International Education Alliance for Education in Radioactive Waste Management, formed in April 1992 with the aim of fostering science literacy in radioactive waste management through international collaboration in education. Other charter members of the alliance are NEA, Austria, Canada, Spain, Sweden, Switzerland and the United Kingdom.

2. Country experience

20. Canada has long had mechanisms to control radioactive wastes and has pursued initiatives in response to technical issues and public concern. In 1989, an independent panel was appointed to conduct an environment assessment and review the concept of disposing of nuclear wastes in the granite rock of the Canadian shield.

21. At the present time, producers of low-level radioactive wastes have to develop their own storage and disposal facilities. The Atomic Energy Canada Unit, a federal government corporation, is planning a demonstration unit of a near-surface disposal facility for its own wastes and those received from source-level producers. A task force was established in 1988 to find a disposal facility for a large proportion of the existing inventory of low-level radioactive wastes in the country - the so-called historical wastes.

22. Past and present research conducted by the industry and the federal Government provides a sound basis for evaluating potential environmental impacts. Nuclear issues in Canada are managed by the Atomic Energy Control Board (AECB); it has established regulatory criteria for decommissioning wastes. Large volumes of wastes are involved and AECB is ensuring that uranium companies fulfil their obligations to clean up the wastes. Recently, the Federal

Environment and Assessment and Review Office established an independent panel to review the decommissioning of uranium tailings in Ontario.

23. Finland has legislation on nuclear waste management according to which each producer of nuclear waste is responsible for the safe management and disposal of the waste and for financing these operations. The Ministry of Trade and Industry oversees and controls proper planning and timely implementation of nuclear waste management programmes. The Finnish Centre for Radiation and Nuclear Safety is responsible for nuclear safety and waste management. The preparations for the future disposal of domestic spent fuels are being undertaken by Teollisunden Voima Oy, a Finnish utility; to this end it has undertaken investigations of disposal sites and identified three sites for more in-depth study. The spent fuel from the Imatran Vioma Oy plant is transported back to Russia, in line with the supply contract.

24. IAEA, at the request of Finland, reviewed, in August 1993, the country's waste management programme. The review covered research and development, by both industry and the Government, with particular emphasis on spent fuel management; the results will be used in the planning and implementation of future research and development.

25. Issues on radioactive wastes have been of concern to Hungary since the commissioning of the nuclear power station in the country. According to the 1980 act of parliament on nuclear energy, licences for construction, operation and related activities shall not be granted unless sufficient measures are taken for the safe storage of radioactive wastes.

26. The Ministry of Public Welfare is responsible for licensing the disposal of wastes. So far no suitable disposal site has been found for the radioactive waste from the nuclear energy plant. An interministerial project was established, involving the Ministries of Industry and Trade, Environment and Regional Policy, and Public Welfare; the National Committee for Technical Development; the Hungarian Atomic Energy Commission; and the Hungarian Power Company. The first phase of the project is to determine the outlines of the strategy for the management and disposal of radioactive waste including spent fuels; it will set financial, technical and regulatory standards and guidelines covering: (a) elaboration of criteria for site selection and waste forms and for the performance of the disposal facility; (b) selection of disposal technologies and sites suitable for disposal of radioactive wastes; (c) quick screening of the country to find potential regions for high- and low-level waste disposal; (d) assuring of the financial basis for waste management (the pricing of electric energy or other methods); (e) enhancing of public acceptance of the site and facility; and (f) selection of procedures and equipment for treatment and volume reduction of radioactive waste.

27. The Netherlands abides by the decision taken at the North Sea Minister's Conference, which recommended that the North Sea was not suitable for developing radioactive waste or for storing such waste in the seabed.

28. The use of radioactive substances in the United Kingdom must be registered and the accumulation of radioactive waste and its disposal authorized. Registration and authorization are entrusted to Her Majesty's Inspectorate of

Pollution (HMIP) in England and Wales; and to Her Majesty's Industrial Pollution Inspectorate (HMIPI) in Scotland and Northern Ireland.

29. Nuclear power stations and other nuclear plants are subject to stringent regulations - by HMIP, HMIPI and the Ministry of Agriculture, Fisheries and Food - covering plant design and construction, and operation and maintenance of facilities, through to decommissioning and disposal of wastes. The safe transport of radioactive wastes is regulated by the Department of Transport. The policy of the Government is to ensure that radioactive waste is managed safely and that the present generation meets its responsibilities to future generations. Policy details are kept under review; to this end, the Government receives advice from an independent committee of experts, the Radioactive Management Advisory Committee.

30. Most of the low-level waste is buried or emplaced in vaults in Cumbria. There have been significant improvements in categorization and handling procedures, with the result that the volume of waste disposed of has shrunk by a factor of four over the last decade. Intermediate-level waste is stored at the sites where it is produced, pending the development of a suitable depository; to this end, geologic investigations are being carried out at a site near Sellafield. High-level waste from the reprocessing of radioactive material is stored at Sellafield and Dounreay. In the former site, waste is being converted to a vitrified form, and will remain in storage for at least 50 years to allow for radioactive decay and heat dissipation.

31. The policy of the United States emphasizes the safe storage of radioactive waste, the development of permanent solutions to radioactive waste disposal and the present generation's accountability for current radioactive waste inventories. The United States radioactive waste policy and programmes are mandated by the United States Congress. Through this and other legislation, the storage and disposal of most commercially generated low-level wastes are assigned to the States, while all other wastes, including low-level wastes of non-commercial origin and Greater than Class C Low-Level Wastes, as well as intermediate- and high-level ones are the responsibility of the federal Government. Most Greater than Class C Wastes come from powerplants' operations and the decommissioning of nuclear reactors. Other sources are sealed industrial and medical generators.

32. The responsibility for radioactive waste management at the Federal government level is assigned to (a) the Department of Energy (storing and disposing of radioactive waste) (b) the Nuclear Regulatory Commission (NRC) (regulating and licensing of certain waste management) and (c) the EPA (setting environmental protection standards).

33. By a 1985 Amendment to the Low-level Radioactive Waste Policy Act, the States became responsible for the disposal of commercial class A, B and C Low-Level Wastes. The Act also encourages the States to form inter-state Low-Level Waste Compacts. Most States and compacts are making progress towards developing their own near-surface disposal facilities and several compacts are expected to have facilities in operation by early 1996.

34. The Uranium Mill Tailings Radiation Control Act of 1978 assigns to the Department of Energy the responsibility for stabilizing and remediating radioactive sites that NRC oversees. The Act also defines NRC's authority to regulate radioactive sites and furthermore requires that any groundwater contaminated by seepage from tailings piles be remediated to EPA standards. The Department of Energy is currently evaluating the feasibility of transuranic waste disposal at the Waste Isolation Pilot Plant (WIPP), whose repository is built deep below the ground in embedded rock-salt.

35. The 1982 Nuclear Policy Act and the 1987 Amendment to the Act designated the Department of Energy as bearing the responsibility for siting and developing geologic repositories for the permanent disposal of spent nuclear fuel. They also authorized the Department of Energy to site and develop Monitored Retrievable Storage facilities for spent fuel storage. The Department of Energy's spent fuel programme has focused primarily on the characterization of a proposed repository site at Yucca Mountain in the State of Nevada, with a view to determining if the site can permanently isolate radioactive materials with geologic and man-made barriers. The Department of Energy also manages the high-level wastes to be disposed of with the spent fuel. Most high-level wastes are in liquid form. Since the plant repository will accept only solid waste for disposal, the liquid waste will have to be vitrified, in other words, converted to glass forms. It is planned that two of the three new wastes vitrification facilities will begin processing in 1996.

36. Mixed wastes are regulated through both radioactive waste legislation and the Resources Conservation and Recovery Act (RCRA), the latter being the basic law guiding the management and treatment of hazardous wastes. The radioactive part of the mixed wastes may consist of low-, intermediate- or high-level waste. The federal Government is responsible for the storage and disposal of mixed wastes and the Department of Energy is engaged in research and development programme focusing on waste management and remediation of sites contaminated by mixed wastes. An <u>in situ</u> vitrification process for mixed waste is being developed.

37. Since 1992, a number of changes have taken place in the legislation on and administration of waste management. Section 801 of the Comprehensive National Energy Policy Act (1992) requires EPA to develop new standards for the protection of the public from releases of radioactive materials at the proposed Yucca Mountain repository for spent fuel and directs NRC to amend its technical requirements and criteria in order for them to be consistent with EPA standards. In section 803 of the Act, the Secretary of Energy is directed to report on the adequacy of current programme plans for managing the radioactive waste that could be generated by nuclear powerplants constructed and licensed after October 1992.

38. The WIPP Land Withdrawal Act withdraws public lands from transuranic waste disposal at WIPP and establishes a new regulatory framework for the facility involving EPA. The Federal Facility Compliance Act contains provisions that affect the management of Department of Energy mixed wastes, including a requirement that within three years, the Department of Energy should prepare treatment plans for all mixed wastes in the Department's possession.

39. There have also been new administrative guidelines; for example, the Department of Energy is to proceed with an evaluation of the Multi-Purpose Canisters (MPC) for spent fuel storage. The Department has also implemented a waste minimization policy aimed at reducing the amount of radioactive waste and pollution generated through the Department's radioactive materials and waste management activities, including avoidance or reduction of the generation of wastes, recycling or reissuing of waste that cannot be eliminated and treatment of the remaining wastes to reduce volume and toxicity.

40. There have also been major developments in storage, transportation, disposal and remediation since 1992. During 1993, several States made substantial progress in developing low-level waste disposal capabilities. Meanwhile, the Department of Energy is investigating metal melting, decontamination and recycling as a strategy for reducing the Department's own need for low-level waste disposal facilities. Several economic and management analysis issues relating to Greater than Class C disposal were expected to be resolved by the Department of Energy in 1993, while in 1994, the Department intended to focus its efforts on higher-level wastes, as well as provide technical assistance to the States and Compact regions.

41. The Department's Uranium Mill Tailings Remedial Action Project has been conducting surface and near surface remedial activities since 1983. In 1993, the Department of Energy began work on eight of the fourteen sites to be remediated. Plans are under way to start work on the remaining six. The Department expects to initiate laboratory testing for transuranic waste package performance; such tests will require several years to complete.

42. The Department of Energy has assessed the adequacy of current spent fuel management planning to accommodate future storage and disposal needs. Meanwhile, the ground-breaking for the Exploratory Study Facility (ESF) at Yucca Mountain began in November 1992. ESF is an underground laboratory that is to house test facilities for the study of Yucca Mountain suitability as a spent fuel and high-level waste repository. In addition, the Department of Energy has begun assessing the feasibility of designing and developing Multi-Purpose Container systems to review, store, transport and eventually dispose of spent fuel. Meanwhile, advanced conceptual wastes package design began in October 1992 in order to evaluate seven alternative design concepts for isolating repository wastes within engineered barriers. The Department of Energy is also evaluating the possible use of actinide burning reactors to minimize radioactive wastes. It has also developed a national inventory of its mixed wastes, as well as of its mixed waste treatment capacity, and it issued an interim report in 1993. Meanwhile, EPA has developed a Volume Reduction and Chemical Extraction (VORCE) technology for treating certain sanding clay soils contaminated by radium and hazardous wastes. The technology has been successfully tested at a remediation site in New Jersey and EPA will administer the technology and also make it available to other United States agencies and to international programmes.

43. NRC has revised its standards for worker radiation exposure (January 1994). It has recently issued revised guidelines for determining classification of low-level wastes and has furthermore continued to take steps to ensure that regulations governing high-level waste disposal are clear and complete. It has

also begun preparing the Licensing Application Review Plan (LARP) which is intended to provide guidelines to NRC staff for reviewing spent fuel and high-level wastes repository licensing applications.

44. Even fewer responses have been received from the developing countries: information has so far been received from Cuba and the Republic of Korea. Within the national plan for environment and development in Cuba, special attention is given to ecologically sound and safe management of radioactive wastes. Low-level wastes from applications of nuclear techniques in medicine and the production of radioisotopes are collected periodically, compared and cemented, and temporarily stored in depositories specifically constructed for this purpose. National bodies comprise (a) the regulating authority, (b) the entities producing the wastes and (c) competent entities for the collecting and treatment of the wastes.

45. The organization for monitoring the management of radioactive wastes was recently consolidated, thus permitting the control of radioactive contamination in the areas surrounding installations, and the environment in general. Capacity-building efforts have been undertaken in recent years towards the development of national nuclear programmes and the protection of the environment. A significant number of specialists and technicians have been trained through different national and international institutions for environmental research and control.

46. The completing and putting into service of plans for the reduction of the wastes that have been temporarily stored have been affected by the difficult circumstances in the national economy. However, negotiations for obtaining the necessary resources through IAEA have been accelerated.

47. Waste to be generated in future electricity-generating plants will be treated, conditioned and stored temporarily within the installations at the plants. Meanwhile, studies will be carried out for the establishment of a permanent storage site.

48. In the Republic of Korea, the Ministry of Science and Technology has the primary executive responsibility for guaranteeing the safe management of radioactive wastes from nuclear powerplants. The Korean Institute of Nuclear Safety (KINS) provides technical support to the Ministry of Science and Technology in waste management areas related to licensing, safety reviews and safety standards. The responsibility for developing national radioactive waste management projects is entrusted to the Korean Atomic Energy Research Institute, whose work also includes the transportation and disposal of low-level waste from nuclear powerplants, as well as radioactive isotopic wastes from industries, hospitals and research institutes.

49. Based on radioactivity laws and atomic energy laws, a long-term strategy for radioactive waste management was adopted by the Korean Atomic Energy Commission in 1988. Efforts currently under way, are aimed at selecting underground radioactive waste disposal sites: construction of low- and high-level sites are scheduled for 1995 and 1997 respectively. Meanwhile, the current producers will bear the responsibility for the storage and monitoring of these wastes.

50. The Republic of Korea has, since 1991, discontinued sea dumping of radioactive wastes, and does not consider it an option. The country plans to construct a specially designed ship for transporting radioactive wastes. Concurrently, a strategy for the nuclear fuel cycle and the decommissioning of the nuclear plant at Paks will be elaborated upon, taking into account preparations for licensing and building an intermediate spent fuel storage facility at the Paks site as well as an investigation into the possible use of siltstone formations for disposal purposes.

51. Safe, acceptable management and final disposal of radioactive waste including spent fuel and waste from future decommissioning require coordination of a multiplicity of activities - scientific, technical, economic, social, legal and political efforts.

3. Technology and finance

(a) Technology

52. As part of ongoing research development programmes, as well as legislative requirements, many countries have been actively engaged in efforts aimed at promoting evolution of methods for the safe and environmentally sound treatment, processing and disposal of radioactive waste and in the assessment of programmes concerned with evaluating the health and environmental impact of radioactive waste disposal.

53. Examples have been given that underscore the fact that the United States is active in new research and development initiatives. Other initiatives include research and development in mixed-waste treatment technologies; the development as well as the refining of environmental standards and criteria applicable to radioactive waste management programmes and activities; and the development of generally applicable environmental radiation standards for the land disposal of low-level wastes.

54. Many countries are cooperating with such organizations as IAEA, IMO, the World Health Organization and the International Commission on Radiological Protection in these efforts. Members of OECD also cooperate and coordinate their efforts with the Nuclear Energy Agency. As part of IAEA's programmes, the organization promotes research and development methods for the safe and environmentally sound disposal of radioactive waste, as well as research assessments of health and environmental impacts. The Agency plans to hold a seminar on radioactive waste practices and issues in developing countries in Beijing, China, in October 1994.

(b) Finance

55. In Agenda 21, it was estimated that the average total annual cost (1993-2000) to international organizations to implement the activities of the programme of its chapter 22 was of the order of $8 million. Actual costs and financial terms, including any that are non-concessional, will depend upon many factors including the specific strategies and programmes Governments decide upon for implementation.

56. IAEA's 1994 programme budget for radioactive waste management is about $5.5 million. In addition, $1.3 million is earmarked for technical cooperation activities which include United Nations Development Programme (UNDP)-financed projects. Another $900,000 comes from extrabudgetary sources, including other United Nations organizations. Additional high-priority funding amounting to $400,000 has been identified but it cannot be carried out through the regular budget. In addition, multi-year programmes for several countries that need improved capacity for radioactive waste management have been developed in detail. These amount to $6 million, out of which some $1.7 million has been sought from UNDP's Capacity 21 programmes.

57. The costs at the national level of managing and disposing of radioactive wastes are considerable and will vary, depending on the quantity and level of waste, and the geologic characteristics of sites technology used for disposal.

4. Capacity-building, including human resource development

58. Countries, in cooperation with relevant international organizations, are called upon, in chapter 22 of Agenda 21, to provide, as appropriate, assistance to developing countries to establish and/or strengthen radioactive waste management infrastructures, including legislation, organizations, trained manpower and facilities for the handling, processing, storage and disposal of wastes generated from nuclear applications.

59. A priority activity within the IAEA waste management programme involves helping developing countries establish national radioactive waste management capacity. To this end, assistance is being provided at the national, regional and interregional levels to member States to establish infrastructure needed for the safe management of radioactive waste, including spent fuels, and to strengthen existing infrastructures.

60. A proposal has been submitted to the UNDP Capacity 21 initiative. At the same time, training needs have been identified in such areas as spent radiation sources management, integrated waste management systems, infrastructure requirements, management of waste from nuclear applications and quality assurance requirements for waste management. IAEA is assisting in arranging for training in these areas on a regional and interregional basis.

61. Canada provides assistance to developing countries through bilateral cooperation and participation in IAEA programmes. To this end, it hosted a training project that included the participation of 25 developing countries. The United States also provides assistance to many developing countries through similar channels.

III. CONCLUSIONS AND PROPOSALS FOR ACTION

A. Conclusions

62. Many countries have been actively involved in the monitoring and safe management of radioactive wastes. Legislation has been enacted or amended, as

appropriate, and safety standards updated. At the same time, active efforts have been geared towards identifying and establishing permanent disposal sites for radioactive wastes. Meanwhile, Governments are continuing their efforts to manage temporary disposal facilities and to find practical measures for minimizing or limiting the generation of those wastes.

63. Particular interest has been shown in developing and implementing codes of practice for transboundary movements of radioactive wastes and in expediting the work of the London Convention, which is geared to replacing the current voluntary moratorium on the disposal of low-level radioactive wastes at sea by a ban. There has also been international cooperation among countries and with international organizations, in particular, IAEA and the Nuclear Energy Agency of OECD.

64. However, problems still remain. The generation of low-level radiation from nuclear applications in medicine, agriculture and many other activities has been increasing steadily. This calls for more concerted efforts towards developing safe storage and disposal of such wastes. For many countries, the disposal of intermediate-level wastes is fraught with many problems. More and more of such wastes are being produced and more storage capacity is required. At the same time, the cost for the management, storage and disposal of such waste is rising very fast; and nobody has any ideas about the nature of future costs.

65. More difficult problems seem to relate to the permanent storage of high-level wastes. Most of the wastes have half-lives countable in million of years. In most cases, the sites that seemed to be satisfactory have turned out to be less so than was hitherto thought. There are also ethical issues connected with passing on the responsibility for the management and disposal of such long-lived wastes to future generations. In this context, it should be pointed out that the precautionary principle has been ignored, especially with regard to nuclear powerplants. Those plants produce radioactive wastes that have been known to be harmful to both health and the environment for centuries. However, no viable, safe and permanent disposal sites have been found and temporary storage sites are being stretched to the limit. At the same time, both conventional and new sources of energy are widely available for meeting electricity requirements. Yet more nuclear powerplants continue to be built.

B. Proposals for action

1. Legislation

66. While, as noted, substantial progress has been made in the monitoring, collection, transportation and storage of radioactive wastes, and whereas a lot of effort has gone into international and regional cooperation in the development of codes of practice and of standards for exposure, a lot more remains to be done. In many countries, legislation has been enacted to address the complex and multifaceted problem of radioactive waste management and disposal; there is nevertheless a need to keep such legislation under review and to amend it, as appropriate, in order to reflect the changing situation. Associated with this is the need to constitute independent panels to review standards, licensing and control procedures. Public participation in such

general discussions and assessment should be encouraged. This is of particular importance because public awareness and acceptance of the management, licensing and, in particular, disposal procedures (regarding sites selection) are crucial.

2. Institutions

67. In many developing countries, one of the limiting factors with respect to action stems from the fact that the institutions for waste management and control are inadequate and the infrastructures weak. At the same time, the quantity of radioactive waste and the number of isotope applications are increasing. The accumulations of spent radioactive sources will therefore require immediate attention. Help from international organizations and international communities will be required in order to develop or improve procedures for the management and safe disposal of these radioactive wastes.

3. Scientific and technical efforts

68. There is need for more research and development into the most suitable facilities and into the reduction of the volume of certain radioactive wastes, utilizing, in the latter case, such procedures as vitrification. Work is also required on geologic studies of potential sites. Further research and development effort is also required in order to establish safety and health standards. While some work is being done on remediation procedures and processes, this is one of the areas that also require particular attention.

4. Financial assistance

69. The management of radioactive wastes is capital-intensive and there is a need to allocate adequate funds for this purpose. Many developing countries will require financial assistance in order to address adequately this very important subject.

5. International cooperation

70. While encouraging efforts have gone into international efforts in regard to radioactive waste management, there is a need to further develop international standards for radioactive waste management that could be adopted by States and would ensure that internationally accepted approaches to the managing and disposing of radioactive wastes in a safe and environmentally sound manner were being followed.

Notes

1/ Official Records of the Economic and Social Council, 1993, Supplement No. 5A (E/1993/25/Add.1).

2/ Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions adopted by the Conference (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1. annex II.

3/ Official Records of the Economic and Social Council, 1993, Supplement No. 5A (E/1993/25/Add.1), chap. I. para. 28.

4/ Ibid., para. 24.

5/ "Finishing the job", World Watch, March/April 1994.

6/ "Nuclear waste, with nowhere to go", New York Times, 28 March 1994.

7/ "For the desperate nuclear waste isn't dreadful", New York Times, 24 February 1994.

8/ "French to make cleaner job of nuclear waste", Financial Times, 15 May 1991.

9/ "Power politics", The Economist, 9-15 April 1994.

10/ John Surrey, "Ethics of nuclear decommissioning", Energy Policy, vol. 20, No. 7. (July 1992) pp. 632-640.

11/ "Closing costs - nuclear utilities face immense expenses in dismantling plants", The Wall Street Journal, 15 January 1992.

12/ Most of the material used in this section is based on the submission of IAEA, which is the designated task manager for chapter 22 of Agenda 21.